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ON THE DEPENDENCE OF WHAT APPARENTLY TAKES
PLACE IN NATURE UPON WHAT ACTUALLY
OCCURS IN THE UNIVERSE OF REAL EXIST-
ENCES.

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(Read April 3, 1903.)

CHAPTER I. INTRODUCTION.

Hitherto attempts to ascertain the events that are actually happening in the universe of real existences, and to ascertain what those existences are—in other words, the study of ontology—have been pursued almost exclusively from the standpoint of the metaphysician of the human mind. This mode of treatment has led to a few negative results which are chiefly of value by helping to dispel some popular errors, but it has established little that is positive, or that can be of service to the scientific student of nature. And yet investigations of Natural Science have been pushed in more than one direction into contact with problems of ontology, and are there brought to a stand owing to the different levels at which these two fields of investigation lie. Examples of this are met with in physiology, when we find our progress blocked on coming face to face with the problem as to what is the true nature of the interdependence between the thoughts of animals and changes in their brains; and generally throughout physics, when we make any attempt to penetrate to the causes of the events that occur. It appears, therefore, to be in an eminent degree desirable that an attempt shall be made to bring natural science and ontology into line by carrying on the ontological investigation from the standpoint of the scientific student of nature.

There are other reasons also why the inquiry should be taken up by scientific men. The difficulties which have to be encountered are perhaps not so much intrinsic as collateral. They all arise from the circumstances under which we, men, have to carry out the inquiry, and are of a kind with which scientific men are better fitted to cope than others. A very serious liability to error is consequent upon the excessively secluded position of the human mind in the universe of existing things. How indirect and how slender the connections will appear in the sequel. This creates illusions greater than those experienced by the old astronomers who were misled by man's being tied to an earth that seemed to them to be stationary. Another chief source of our difficulties is that we have to enter on this study hampered by crude beliefs in which we have been brought up, which are embedded into the language we are obliged to use, and in which we habitually think; but which the inquiry shows to be a jumble of truth and error. These we must make it our business to correct, retaining the germ of truth in each, and by slow degrees acquiring the power of amending, promptly and without effort, all those parts of these beliefs which require correction. We are far from having done enough when we merely become aware of the errors; nor is it even enough that we shall have discovered what ought to take their place. We have not accomplished our task till it becomes our second nature to do this habitually and without premeditation, with regard to all that is about us and all that is within us. This takes time. But when it is accomplished the reward is great. A special difficulty arises from our being obliged to use some one of the languages that can be understood by our fellow-men. Every language that has been devised by man implies mistaken views in ontology; and that not occasionally, for every human language is permeated by these errors.

Now, students of natural science, men who have had an extensive training in the study of nature, and especially those who have devoted themselves mainly to the dynamical and physical aspects of that study, are better equipped for contending successfully with these difficulties than are their fellow-students whose main training has been confined to the tiny plot which lies within the ring-fence that surrounds the works of man—the languages he has devised, his literature and history, his music, poetry, architecture, painting and sculpture, his jurisprudence, his moral relations, the metaphysics of his mind, and so on; in fact, all branches of what in our universi-

ties are called the humanities. Explorers of nature, investigators of the work done or being done *which is not man's work*, stand a better chance of success than those whose thoughts mainly travel within the narrower range: and on several accounts; first, because they find less difficulty in freeing themselves from the limitations of the human standpoint, which we may liken to the Ptolemaic point of view, and in grasping the wider resources of a more Copernican survey; largely, too, because they more easily become expert in using such symbols as words in a generalized or otherwise modified sense when it becomes necessary to do so; but perhaps most of all because they are already familiar with the contrast between the two kinds of supposition which those physicists who use language carefully distinguish as *theories* and *hypotheses*. As some readers of the papers I have already written on these subjects have found here their chief difficulty, it appears desirable to devote a chapter of this essay to its elucidation. This, indeed, is almost necessary; inasmuch as sound progress in the task before us is not even possible unless this distinction is clearly grasped, and unless a facility has been acquired in handling both hypotheses and theories without risk of the confusion between them which has been too often made.

CHAPTER 2. OF THEORIES AND HYPOTHESES.

Both theories and hypotheses are suppositions—a theory means a supposition which we hope to be true, a hypothesis is a supposition which we expect to be useful. Theories accordingly are either correct or incorrect, true or false, quite irrespectively of whether we, men, can make much, or little, or any use of them. *The merit of a theory is simply to be true.* It often, indeed usually, happens that the true theory is also useful; but it by no means need be so. Accordingly, the question whether a particular theory is of any use is irrelevant.

On the other hand a hypothesis is a supposition which aims at being useful, and *which is legitimate if useful.* A hypothesis may be a theory—in other words, a supposition which we make expecting it to help us forward in our investigation, may also be the supposition which we think to be true: but it by no means need be so; and in fact the best, *i.e.*, the most useful, hypotheses are often of the kind that make no pretense to being true. For example, all applications of mathematics to the investigation of nature are de-

ductions from data, in which simpler machinery is intentionally substituted for complex operations going on in objective nature. Thus, in computing the mutual perturbations of the planets, the planets are treated as though they were spheres, made up of untextured spherical shells, each of uniform density throughout; and it is left out of account that they approach to being spheroids, with mountains on their surface, irregularities of a like kind at greater depths, rocks in those mountains, minerals in those rocks, a different molecular texture in each mineral involving numberless motions among and within the molecules; moreover with tidal strains, heat expansions by day, contractions by night, and so on; perhaps seas and an atmosphere, vegetation and animals, all in constant and complicated movement; with a multitude of other details. Now it is legitimate to omit all these from our calculation, for though every one of them produces its effect in actual nature, the difference between their joint operation and that computed from the immensely simplified hypothesis made by the mathematician, can be shown to be too small to make any approach to being detected by any human appliance. Hence, for any purpose which is of use to man, the approximation arrived at by the simpler problem is sufficient, wherever the errors are of such a nature that they are not cumulative. *Nevertheless, it should be clearly recognized that it is a model of nature—a mechanism illustrating nature—and not nature itself, that has been mathematically investigated.*¹ So it is with all dynamical

¹ This has been sometimes overlooked. A recent instance is in a determination of the rate at which gases escape from atmospheres, based on the insufficient data commonly used in the mathematical investigation of such problems, and leading to a rate for the escape of helium from the earth's atmosphere which is negated by observation (see Bryan, on the Kinetic Theory of Atmospheres, *Phil. Trans. of the Royal Society*, vol. 196 A, 1901, p. 1; and Stoney, on the behavior of helium in the earth's atmosphere, *Astrophysical Journal*, vol. xi, 1900, p. 369).

In such cases it may be difficult, and is sometimes impossible, to put our finger on the oversight that has been made. In this instance it may be conjectured with some probability that the mistake has been in the tacit assumption that the partition of energy between the internal and the translational motions of the molecules takes place with a frequency which warrants our arguing from the supposition, tacitly made in the mathematical investigation, that it goes on without intermission. There seems reason to believe that this partition of energy actually takes place, not at every encounter, but only at encounters as infrequent from the molecular standpoint as those that make chemical reaction possible between the molecules of a mixture of suitable gases. Now this, in the case of a mixture

investigations: the data of nature are loaded with minute detail and are far too much involved; they have to be simplified to bring the task within the range of man's power over mathematical analysis.

But for our present purpose a specially instructive instance is found in Geometrical Optics. The correct objective theory of light appears to be that light consists objectively of waves of alternating electro-magnetic stresses advancing through the ether. Now the whole of Geometrical Optics—which is one of our most useful sciences—is built upon the supposition that light consists of rays—a supposition which must not be mistaken for a *theory* of light: on the contrary, this supposition is to be employed as a useful and therefore legitimate *hypothesis*. In Geometrical Optics what we investigate is the succession of events, not in nature, but in a model of nature. We have substituted a model which contains far more easily handled machinery than that which operates in nature, every step in the progress of which can be foretold by the application of singularly easy mathematical analysis, can be represented in easily understood diagrams, and can be imagined and followed without difficulty by students who possess but little skill. What a loss we should sustain if that most useful hypothesis were not available! the justification of which is that it is so easily dealt with, and that it furnishes results that are true within known limits. For example, the new machinery furnishes the correct positions of optical images, although the image itself, the geometrical image as it is called, differs in material respects from any real image. Thus, it presents us with an unlimited amount of detail, much of which must be regarded as false, because it is detail which does not exist in the images produced by nature. The hypothesis is useful *within* certain limits, but will mislead if misapplied.

of equal volumes of hydrogen and chlorine, only occurs about once in 1000 million encounters in sunshine, and less frequently in feebler light, down to about once in 100 millions of millions of encounters, so far as the observations have been recorded. An infrequency of this kind would have but little effect at the bottom of our atmosphere, but would make the distribution of molecular speeds differ altogether from that which has been computed in that penultimate stratum of the earth's atmosphere from which the escape takes place.

CHAPTER 3. OF THE ABSOLUTE AND RELATIVE SIGNIFICATIONS OF TERMS.

We may make use of Geometrical Optics for another purpose—to illustrate the variety of meanings which such words as existence, theory, hypothesis, actual, real, etc., may have. They are freely used in Geometrical Optics. They are there used in a *relative* sense, in subordination to the hypothesis that light consists of rays, which for the time being must be left unquestioned, and which we may call the master hypothesis, as it governs the use to be made of those terms. Thus we speak of *real* rays in front of a mirror, and of *virtual* rays behind it; we say that the true *theory* is that the image on the retina is formed by rays reflected from the front of the mirror, but that it is legitimate to make the *hypothesis* that they emanate from a virtual image behind. When, however, we take the wider view that light is an electro-magnetic *undulation*, we recognize that what a moment ago we called real rays are not real, but a machinery substituted for what is real in the new sense that we have now to give to that word. For we are now using the term *real* in subordination to a much wider hypothesis, viz.: the great objective hypothesis that not only do our perceptions exist temporarily, but also that each of those *syntheta of perceptions* which we call natural objects exists as a whole and persistently. And when we come in turn to recognize that this, in its turn, is not the true theory of existence, but only an eminently useful hypothesis—probably, indeed, the most useful hypothesis known to man—and when we find that we must advance a step behind it to reach the true theory of existence, then at last we reach the stage at which we may use the word *real* in its fullest *absolute* sense; if we succeed in acquiring a right to apply it to what is going on in the autic universe, the universe of real existences. Thus such terms as existence, theory, real, actual, etc., only attain their absolute, which is their fullest, meaning when applied to the events that go on in the Universe of Auta; and are to be understood in their objective, which is a relative, sense when applied to what we regard as going on in that great objective hypotheton which we call nature; and in another still more removed relative sense when used in subordination to the narrower hypothesis which we have to entertain while investigating nature by the science of Geometrical Optics. When once this is clearly understood we are warned, and in some degree forearmed,

against falling into mistakes between the various shades of meaning which the poverty of language obliges us to put up with in such terms as existence, theory, actual, real, etc. If in any context we have occasion to employ any of these terms in more than one of its permissible meanings, it may sometimes be advisable to distinguish between them in some such way as that which is familiar to mathematicians when they write a, a', a'' , etc., for different quantities. Availing ourselves of this device, we may write [real], within square brackets, when we wish to make it explicit that the word is to be understood in its absolute, that is in its autic, sense; and [real]', with a dash, when the word is used in its objective, which is its principal relative, sense; while [real]"', [real]''', etc., may be used to signify the other relative meanings which the term has when used in subordination to more limited hypotheses, as when we describe the rays of Geometrical Optics as being some of them [real]" and others virtual. The same treatment may be extended to any other terms that seem to require the precaution. It is against mistakes between the *objective* and the *autic* significations of words that we have to be most on our guard. This will become clearer as we proceed.

CHAPTER 4. OF AUTA: AND OF THE MEANING TO BE ATTRIBUTED TO THE WORD *totality*.

It may be seen from the foregoing pages that the human mind is better fitted to cope with the scientific study of what apparently occurs in nature, than with the attempt to penetrate behind nature to the causes of these appearances. To do this requires us to inquire what has been happening in the universe of real existences, and to endeavor to determine what those existences are.

In the scientific study of nature we travel along one of the great *highways* of human thought; in ontology we have to make our roads as well as to push our way along them. It is therefore all the more important that we should bring to our aid every help which the scientific study of nature can supply. The present essay is an attempt to avail ourselves of this assistance.

Let us for convenience call the real existences *auta* (τά ὄντα αὐτά)—the very things themselves. An auto, then, is a thing that really exists, and in no wise depends on the way we—human minds—may happen to regard it. Our impressions or beliefs about it may be correct or may be erroneous, but the term auto means the thing *itself*.

We may also use the term *universe* to mean the *totality* of these *auta*. To prevent confusion, it may be well to designate the totality of natural objects by some other name. We may call it *nature*, or *the cosmos*, reserving the term *universe* for *the totality of auta*. Or, if at any time the word *universe* is applied to the totality of natural objects, it may be written with a dash, the objective [universe]', to distinguish it unmistakably from the autic [universe]. It is to be noted that here and elsewhere the word *totality* is to be understood as having a more comprehensive¹ meaning than the word *aggregate*. Any collection of *auta*, however disorderly, would be an *aggregate* of those *auta*. By their *totality* is to be understood those *auta*, *under one definite set of conditions*—viz.: under the conditions that actually prevail—with those mutual relations, performing those operations, undergoing those changes that actually occur.

CHAPTER 5. IN WHAT SENSE THE TERM *thought* IS EMPLOYED.

We shall want a term which is applicable to *everything* of which I or my fellow-men or the lower animals can be conscious; and as at present no word in the English language has this wide signification, we shall extend or generalize the meaning of the term *thought*, so as to make it serve. Accordingly *thought*, in the generalized sense in which we shall use it, embraces sensations, perceptions, beliefs, feelings, memories, emotions, sentiments, judgments, motives, acts of will, and so on—in fact, everything which comes within the consciousness of any animal. I shall also use the term *I*, or *the ego*, or *my mind*, to denote the totality (not the mere aggregate) of a certain group of these thoughts, which may be spoken of as *my* thoughts. Observe that the word *mind* is here used in one of the two significations which it has in the English language, and that it will not in the present essay be used in the other of those senses. Accordingly, in the present essay, the term *mind* will not be used to signify the 'spiritual substance' which, according to a view very widely entertained, is supposed to be in existence, as well as the

¹ In Formal Logic the *comprehension* of a term is *the collection of ideas* which are included in the definition of the term. Accordingly, the greater the comprehension of a term, the fewer will be the individuals to whom that term can be applied. This is expressed in Logic by saying that the greater the *comprehension* of a term, the less is its *extension*. For example, Spaniard is a term which has a greater comprehension and a less extension than European.

thoughts. This supposed existence, if there is occasion to speak of it, will be called the man's spirit ; but his *mind*, at a given time, will mean simply *the totality of a certain definite group of thoughts* at that time.

CHAPTER 6. THE POSTULATES OF THE PRESENT INQUIRY.

We are now in a position to present a list of the postulates upon which our further progress will be built. Almost all men are agreed that these beliefs are fundamental, and most men would add considerably to the list. The very short list here set forth has been obtained by excluding from the longer list all that on trial were found not to be necessary for our inquiry.

Postulates.

First Belief.—That my present thoughts exist.

Second Belief.—That my remembered thoughts have existed.

These two beliefs involve a third, viz. :

Third Belief.—That time relations exist.

Fourth Belief.—That minds more or less resembling mine exist in my fellow-men and in some other animals.

Observation.—By intercourse between my mind and the minds of my fellow-men I learn that they experience sensations which are closely related to those that present themselves as a part of my mind. Whence, and from much other evidence, I infer :

Fifth Belief.—That my sensations and theirs have their source in some existing thing or things which are not any part of my own present or past thoughts.

Bishop Berkeley entertained this belief as emphatically as other men. He held that sensations are produced in human minds by acts of will of a "governing spirit."

Sixth Supposition.—Another belief is freely made use of in the present essay, viz. : that my organs of sense and parts of my brain are in some way associated with the introduction of sensations into my group of thoughts.

This belief is, however, not a necessary postulate of the investigation. The argument can be stated in language which does not

include it; but the supposition is true, and therefore unobjectionable, and it is introduced thus early because without it we should be obliged to use unfamiliar forms of expression which would be less perspicuous.

With the same end in view, viz., to attain lucidity, the language of causation is freely used throughout the essay, but will be found not to involve anything beyond what is included in the fifth of our postulates until we enter on the consideration of "efficient" causes.

CHAPTER 7. OF EGOISTIC AUTA, AND OF SENSE-COMPELLING AUTA.

My own thoughts are, at all events, things that exist (Postulates 1 and 2): they at least are auta so long as they last. They are, accordingly, while they last, a part of the universe of existing things. But they are not the whole of that universe. In the first place, the thoughts of other men and the thoughts of the lower animals are also things that exist (Postulate 4). And beside all these auta there are also auta of the kind that produce effects within men's minds through their [organs of sense]¹ (Postulate 5). This is a complete enumeration of auta—things that exist—so far as known to man.

The minds of my fellow-men and the minds of the lower animals may conveniently be classed along with my mind as *the egoistic part* of the universe—being the part of the universe which I am already in a position to know consists of auta of the same kind as those that make up the ego.

Auta of the other kind we may provisionally speak of as *sense-compelling auta*, in contradistinction to my mind and the minds of other men and animals, which are groups of auta that receive certain definite additions when and so long as our [organs of sense] are forced into action by sense-compelling auta. The totality of these sense-compelling auta we may, for brevity, designate *the*

¹ By [organs of sense], within square brackets, are to be understood the real existences, the antitheta in the autic universe, which cause in us those perceptions which when synthetized furnish the phenomenal objects to which the term *organs of sense* is also applicable, and which, when we have occasion to distinguish them from their antitheta, may be written [organs of sense]', with a dash.

The antitheta are popularly imagined to be 'material substances' of the phenomenal objects: but this conception of them conveys an entirely erroneous idea, as will appear in the sequel. See also Chapter 4, above.

sense-compelling universe, which will accordingly mean the same as the sense-compelling part of the universe.

The whole universe, then, as known to man, consists of this sense-compelling universe and of the thoughts of men and animals. This division is convenient, although it is faulty from a logical point of view, since we shall find that the parts of which it consists overlap. We shall, nevertheless, make use of the distinction provisionally, for the sake of its great convenience to us, *i.e.*, to minds that consist of egoistic *auta* when venturing upon the study of other *autic* existences.

CHAPTER 8. OF THE COMMUNICATIONS MADE TO ME BY THE SENSE-COMPELLING PART OF THE UNIVERSE.

Now when I open my eyes or exercise any of my other senses, sense-compelling *auta* transmit messages to me through my [organs of sense]. These messages finally present themselves as parts of my mind, of *my* group of thoughts; and *in the actual form in which they arise within my mind* I propose to call them *tekmeria*¹—signs within my mind that events are happening in a part of the universe that is distinct from my mind. Thus, when I look towards the fire in the room in which I sit, the actual existence, the sense-compelling *auto*, the antitheton of the phenomenal object, which in its relation to us it is appropriate to call the *aitio*-fire (*το αἰτιον*, that *part* of the entire body of causes leading up to anything to which we may *attribute* that thing), transmits one message or signal to me through my [eyes], *viz.*: what is commonly called the visual appearance of the fire. This is one *tekmerion* made to be a part of my mind by the *aitio*-fire so long as it is acting upon me. When, at the same time, I hold out my hands, it transmits a second message to me, the perception of warmth, through another of [my senses]. And it sends another *tekmerion* to me, another witness that it is in existence and producing effects, through my [sense of hearing], *viz.*: the sound of the flame playing over the coals.

Thus, so long as I am employing my senses upon the fire, some cause which is distinct from my mind, *i.e.*, which is not a part of my little group of thoughts, is in three different ways and in each of them a very indirect way, sending me what may be called telegraphic signals; and these three *tekmeria* become, for the time, a part of that fluctuating group of thoughts which is my mind.

¹ *Τεκμήριον*, a sign which is at the same time a proof of something.

To prevent misapprehension, it may be well, before going farther, to invite attention to the guarded statements that have been made, which, while embodying the whole of what may, up to the present, be legitimately inferred from the six postulates upon which we construct our argument, do not include the further illegitimate statement, which is usually added, that the aition, or source from which the messages have been transmitted to our mind, is a 'material substance' occupying that portion of space which is apparently occupied by the phenomenal object. This mistake, so often made, seems to have its source in an impression that the cause (the aition) will resemble its effects (the perceptions which, when synthetized, build up the phenomenal object). The presumption is quite the other way; notwithstanding which, when men are forming their ontological judgments (and all men have to form ontological judgments of one kind or another), they often tacitly assume that causes are like their effects, or suppose that the relations between the causes are of the same kind as those which they find prevailing among the effects. We should be very carefully on our guard against these errors.

What may legitimately be stated is that some of the *auta* of the sense-compelling universe have been operating upon one another and have produced extensive changes—changes which may have affected the *auta* themselves or their relations and operations. Of this widespread effect, some small—excessively small—outlying portions have filtered as far as to my mind, to my little group of *auta*, through a chain of intermediate effects within certain narrow and tortuous channels, my [organs of sense]. In the form in which they ultimately reach me they are *tekmeria*, signs to me that events are occurring beyond my own mind.

CHAPTER 9. OF MY MIND AND ITS SYNERGOS.

In ontology we are confronted with a difficulty bearing some relation to that experienced by biologists in their attempts to arrange the genera and species of plants or animals in a satisfactory natural order. In their floras and faunas they are obliged to adopt a linear arrangement; whereas the progress of the events that brought about the morphology with which they are dealing did not follow any such single line. So, in ontology, expositions, like that here attempted, must proceed, chapter after chapter, in a linear pro-

gression; whereas at one stage we may find ourselves in want of knowledge that cannot be satisfactorily dealt with till some subsequent stage. We are in this predicament at present. For further progress in this inquiry it is essential that we shall know something about the synergos (συνεργός, a coadjutor or co-operator) which is associated with my mind in all, or almost all, its operations, which contributes largely to every message that my mind receives from abroad, and to every message that comes down to it through memory from its own earlier experiences; and without which my mind would, in fact, be an absolute blank as regards all that is going on outside itself, and would be destitute of any knowledge of its own past thoughts. As the relations between this synergos and the mind have to be dealt with prematurely, the reader is requested to pardon the intrusion into this chapter of matter which cannot be adequately expounded till farther on.

The [events]' in a man's brain¹ which are associated with the thoughts that are his mind, do not occur except while the man is alive; and only, during life, when he is either awake or dreaming. All these objective events can be shown to resolve themselves in ultimate analysis into motions of one kind or another going on in, or in connection with, the brain. But they are far from being the whole of the motions of which (under the diacrinominal view of nature, see Chapter 17) the brain consists—in fact, they are an excessively small and quite peculiar selection from the totality of motions that are the brain. It is possible to satisfy ourselves of this by instituting a comparison of time relations. Accordingly, a bystander would see this selection of motions going on in my brain while I am awake, if he could make it an object of observation, and if his senses were acute enough to see all that is going on objectively. If, however, he could see all that is going on objectively, he would see a vast deal more than the changes or motions that are associated with my thoughts. We thus, and from other evidence, learn that the aitia-brain—the source in the autic universe of the perceptions and ultra-perceptions which make up that object of nature which we call the brain—is a collection of auta which includes many more auta besides those that are my mind: and these 'many more auta' are the synergos.

¹ By [events]' is to be understood events in the *objective* world which we call nature. If written [events], without the dash, it would denote events in the universe of auta.

The group of *auta* which includes the *auta* that make up the mind along with those that make up its *synergos*, is the true existence in the autic universe which corresponds to that natural object which we call the brain. The prevalent belief that the true existence is a 'material substance' hovering about that portion of space within which the phenomenal object appears to be situated, is an utter mistake, although it is a belief which has been handed down to us by generations of our predecessors, and in which we were all brought up. Numberless are the errors which have crystallized about the phrase 'material substance'; and the mischief that has been wrought by them may be judged from the circumstance that they have quite shut out of view the wonderful capabilities of the true autic existences, of which we get one very instructive glimpse when we find that the thoughts that are our mind are a small—a very small—part of one of them.

Superstance would be a less misleading term than substance; but it is better to cut ourselves completely adrift from all the misleading associations bound up with the word substance. When the relation between a natural object and its autic cause is under consideration, the present writer has found it convenient to speak of the natural object as the *protheton* and the autic cause in the sense-compelling universe as its *antitheton*. Using this nomenclature, the *brain* of a man is a *protheton*, and his *mind* + *synergos* are its *antitheton*. The mind + *synergos* are a part of the true autic universe: the brain is a part of that hypotheton which we call nature.¹

With this imperfect treatment of the subject we must be content

¹ The labors of physiologists lead to the conclusion that no thought becomes a part of the mind of any animal without being accompanied by some change in its brain, using the word brain here to mean, not the onto-brain but the objective brain, which is a part of nature. These objective changes are motions of some kind. Hence we find here an instance in which the autic anthitheta of certain motions are thoughts.

The above relation is often so stated as to imply that the change in the brain is in some way the cause of the thought. This is to mistake the weather-cock for the wind. What occurs in the autic universe is the cause of the appearance of change in nature, and not *vice versa*.

Nevertheless it is legitimate for physiologists to work, as they usually do, under the *hypothesis* that it is the objective events that cause the autic; provided that they do not make the mistake of supposing that this interchange between cause and effect is theory.

until we can resume the discussion with the advantage of having learned what a natural object is, and what space relations are.

CHAPTER 10. OF PERCEPTIONS.

The tekmeria, the messages from abroad, as I experience them when an auto acts on me through my [senses], are more than mere sensations. To enable me to see this it is only necessary for me to direct my attention to the remarkable judgments about space relations which have annexed themselves to, and in some cases even substituted themselves for, my sensations. When I hurt my foot and when I hurt my elbow there is a difference in the sensations; and this difference my mind, largely assisted by the synergos,¹ has come to translate into *the perception of a space relation* between these two sensations, and between them and others. Thus the first pain is felt as a pain in the foot, *i.e., in or about a certain position in space*; the second pain I similarly *localize*. So also with other sensations when they have come to be transformed into perceptions. The red which I now see in each coal of the fire is a sensation which seems to me of a certain shape and size, and at a certain distance from muscular sensations which I feel at the same time, viz.: the sensation of turning my head towards the fire, of converging my eyes in succession upon different parts of it, the sensation of now and then winking, and the sensation of making and maintaining the focal adjustment of my eyes: all of which latter

¹ The physiological view of these events would be somewhat as follows: the hurt foot and the hurt elbow are in communication with different regions of the brain, and the [effects]' produced in the brain are not the same in the two cases. Although part of these effects are the protheton of the thought in the mind, much more of them are the protheton of changes in the synergos; for, whatever the change in the brain has been, it *must* have included a body of molecular events and others with time-relations too rapidly varying to be the protheton of any such slowly changing auto as a human thought. These accordingly are part of the protheton of the synergos, since the brain as a whole is the protheton of that group of auta which includes both the thoughts that are the mind and those other auta that are the synergos. And as the more slowly changing events in the brain and those that change more rapidly are so interdependent that neither can be other than it is, without its affecting the other, so are the thoughts in the mind and the autic events in the synergos interwoven and they affect each other. It would also appear that in dreamless sleep, those special slower events spoken of above cease to occur within the brain. But some, at least, of the swifter ones are still present, so that at such times the whole antitheton of the objective brain consists of the synergos only.

sensations appear to me to be located elsewhere, viz.: at or near *the centre of space*, as I apprehend space. So also with the sensation of warmth which seems to me to be *on the surface of my hands* when I hold them to the fire. Now sensations which thus appear to occupy positions in space are *perceptions*.¹

In such cases the perception is far from being a mere coexistence of sensations. It is the result of a very subtle synthesis, a synthesis usually of many sensations and of my mind's present and past experience, with probably other materials. My mind assisted by its synergos could not have effected this synthesis but for their inherited tendency to make it and their inherited capacity for doing so.

By the synthesis which results in my *visual* perceptions, a very remarkable co-ordination has been effected between the muscular, the tactual and the visual sensations produced in me by sense-compelling autæ; an equally remarkable co-ordination between the perceptions of my own mind and the perceptions of my fellow-men and of other animals; above all a co-ordination between my own perceptions, past, present and future: which co-ordinations enable me promptly to form correct predictions and are *of the greatest service to me in regulating my acts*. Natural selection has probably helped to develop them. Of all the syntheses by which the mind assisted by its synergos succeeds in translating sensations into perceptions, that which provides us with our visual perceptions appear to accomplish the greatest and most useful transformation. The intense tendency to make this particular synthesis and the extraordinary facility with which I can effect it, are no doubt due to the frequent repetition of the process in an immense series of progenitors: and, in fact, there is evidence to show that the co-ordination, substantially as my synergos and I now make it, had been effected in my ancestors at a very remote geological period.²

¹ Perceptions are distinguished from our other thoughts by having relation to *two* situations in space—to that position in space which the object observed seems to occupy (or, in the case of warmth, to some situation on the surface of the body), and to that position which seems to be occupied by the portion of the brain which is affected when this particular thought presents itself in the mind. Our *other* thoughts—affections, beliefs, sentiments, motives, etc.—have relation to only one of these situations in space, viz.: to the situation in which the part of the brain affected seems to be located.

² Before birds were differentiated from other vertebrates. See the marvelous representation of balls within sockets or beans within a pod, each supported by a little stalk, which is found on the secondary wing feathers of the male Argus

A synthesis does not mean merely the act of collecting materials together. It means that and much more, viz.: the building up of a definite structure (*συντίθημι* includes the meaning of the Latin verb *construere* as well as of *colligere*). The completed structure may be conveniently called the *syntheton* (*σύνθετον*, the structure resulting from synthesis).

It is to be noted that these syntheta, my perceptions, while they last are auta, real existences: they are thoughts, parts of my mind. In fact, up to the present we have been dealing exclusively with auta, things that really exist, some of them non-egoistic, others of them parts of my own little group of auta. But in the next step which the mind takes—a very important step—it transcends these limits.

CHAPTER II. OF HYPOTHETA.

Hitherto we have treated of auta, *i.e.*, real existences, with as little reference to hypotheta, or supposed existences, as was found practicable. It is impossible for a student of ontology commencing his inquiry from the mental attitude in which we, men, must start, wholly to disentangle auta and hypotheta from one another in the earlier stages of his inquiry; but this becomes more and more feasible as he proceeds, until, in the end, there need be no outstanding confusion at all.

In the present chapter we direct our attention to what is probably the most important hypothesis that the human mind makes, a hypothesis of which we all make daily use, and which confers upon me and upon my fellow-men and upon other animals—in fact, upon

pheasant. This most astonishing work of art produced, by nature, is effected by six or seven different colors or shades of color disposed in the same way in which a human artist would lay them on with his brush to produce the same effect.

Darwin, in his *Descent of Man*, has shown how Variation with the coöperation of Thoughts in the minds of the cock and hen pheasants, can account for the development of these wonderful artistic productions. The thought on the part of the cock is a desire or impulse to please the hen by an exhibition of his plumage, and the thought on the part of the hen is an appreciation of different degrees of excellence in the artistic effect achieved in the pictures submitted to her judgment. This implies that the hen bird possesses the same wonderful power that we possess of translating coloring and shading into form; which therefore was attained by our ancestors before birds were differentiated from other vertebrates, unless (which is less probable) it has been separately developed along the two lines of descent since that time.

all the minds that consist of egoistic auta, *i.e.*, minds which are supplied with information through organs of sense—an inestimable benefit, by creating for our advantage those *supposed* existences which are called natural objects. They arise in the way described in the next paragraph: and according as we make progress in tracing out the way in which they arise, it will become obvious why they do us such inestimable service.

Perceptions—*i.e.*, sensations which appear to me to be planted out in space—are the tekmeria or messages which I receive from sense-compelling auta. Auta of this kind form a part of my group of thoughts whenever and so long as any sense-compelling auto is acting on my mind and my synergos, through my senses. But the perceptions which it creates within me at any one time are but a small part of all the tekmeria that it can send to me. Which of all the possible tekmeria shall exist at any one instant depends on the particular line of communication which is at that time open between the sense-compelling auto and me; and whenever I make those changes which are popularly described as “looking at the object from a different side,” “touching it in a different place,” and so on, what I do is simply to change the channel of communication without altering the sense-compelling auto. But I thereby alter the perceptions, the tekmeria which reach me from it. Now the sensible *object*—which persons untrained in the study of their own mind are apt to mistake for the cause of their sensations—is simply the result of the mind and its synergos effecting a synthesis of all these tekmeria. They cannot actually exist, except in succession; but my mind, aided by its synergos, has the power of *conceiving* them as though they existed—

1. Simultaneously,
2. Persistently, and
3. Without being any part of itself.

In this power of conception consists its power of effecting this most useful synthesis.

It is of importance to bear in mind that while I am what is called “looking at the object,” one of the tekmeria, my visual perception at that time is *actual*—that is, it is in true autic existence; the rest of the perceptions which are compacted along with it to make up the syntheton are *potential*—that is, they are not at present in existence, but they can be brought into existence. When I “turn

my eyes away," none of the tekmeria are actual: they are all potential. Meanwhile the originating auto continues in existence during all this performance, and will, with certainty, reproduce the first-mentioned tekmerion if "I turn my eyes back," *i.e.*, if the channel of communication between the sense-compelling auto and me is reopened.

It thus appears that the sensible *object* is not at all made up of any of the parts of which the sense-compelling *auto* consists, but only of certain minute outlying portions of the widespread effects of its great activity, viz.: those effects which, by its activity, it can produce within me through a few narrow and tortuous passages; while at the same time most of its great activity is being expended in other directions. This clearly shows—

1. That the sensible object is not the auto; and
2. That for all human purposes my attaining a knowledge of this hypothetical existence is as useful to me as if I knew what the auto is.

It, in fact, tells me, *in a direct and in the most compendious form*, what effects the auto, under every variety of circumstances, *will produce within me*; for it is itself a structure *built up of these very effects put together*.

It is to be observed that ordinary language is throughout built upon the erroneous popular belief that the objects of the phenomenal world are existences, in the autic sense of that term; and, moreover, that they are the cause of the perceptions that come into existence when we exercise our senses. This is a mistake of the kind which is called "putting the car before the horse": it is to imagine that a structure built up out of the effects of a thing can be the cause of those effects. The sensible object is built up of perceptions instead of being the cause of them. Their cause is to be sought in the sense-compelling universe of *auta*, not in the phenomenal world of *objects*. We must always be careful to distinguish between autic or true existence and objective existence, which means forming a part of that great objective hypotheton which we call nature. We may sometimes find it convenient to distinguish between them by writing [existence] for autic existence, and [existence]' for objective existence. Autic existence means existence in the absolute meaning of that term; objective existence

means existence in a relative sense, namely, what we are to regard as existence under the Objective Hypothesis.

Ordinary language suggests to all who use it a number of mistakes of the kind referred to in the last paragraph. It is, accordingly, apt to mislead us very much, and we must be constantly on our guard against illusions into which we may but too easily be led by the usages of common speech, and by associations which have grown up around familiar forms of expression. Illusions will be found to lurk in what are apparently quite harmless forms of expression, such as "I perceive a cloud moving across the sky"; and to get at what we are really justified in believing, it is well *diligently to practice ourselves* in converting such expressions into less misleading forms, *until we do so with facility*. Thus the foregoing statement is equivalent to—

1. I am a fluctuating group of associated thoughts, and the perception of a moving cloud is for a short time one of this group. This is an autic group.
2. The perception of a moving cloud is also a part of *another* group, in which it is joined, not with the other thoughts at present in my mind, but with all the other perceptions which the antitheton of the cloud *could successively produce* in my mind.
3. This useful hypothetical group, which may be called the objective cloud, is not the cause of my perceptions. Their true cause must be sought elsewhere, and, to give it a name, it may be called the aitio-cloud, or the onto-cloud. It is the antitheton, in the autic universe, of the objective cloud. The objective cloud is the protheton of this real existence, and is a part of the great hypotheton which we call nature.

Nature is here used to signify the totality of all *sensible objects*. This definition is in accordance with the usual acceptance of that term.

We have passed successively under review two acts of synthesis—the *synthesis of the first order*, whereby sensations are transformed into perceptions; and the further synthesis, which may be called a *synthesis of the second order*, whereby perceptions are built together into the sensible objects around us, each of which is a kind of synopton, or collected view, of materials only a small part of which

are in existence at any one time. But, in reality, these two acts of synthesis are now carried on by my mind and its synergos simultaneously and with astonishing ease and promptitude; and it is probable that the gradually acquired power to make them was developed *pari passu* in my ancestors at a very remote geological period.

The instinct which impels us to assign a position in space to sensations affects our visual and tactual sensations most, including under the latter term our muscular sensations, as well as sensations of roughness, smoothness, resistance, hardness, softness, and some others. We also perceive it conspicuously in the allied sensations of tickling, warmth, coolness, pain, and several others. We localize with somewhat less precision our sensations of taste and smell: and of all our more conspicuous sensations sound is that which we least refer to a definite position. We have less power of doing so than many other animals who are furnished with ears which can be turned so as to distinguish the direction of sound; and far less power than some nocturnal insects who, by their feathery antennæ, which are their auditory apparatus, are able to determine the direction of a sound with a precision approaching that of eyesight.¹ In man there are but slender materials for the synthesis.

It may make some parts of this and of the succeeding chapters clearer to give here a definition of the term *object*. This term might be applied to the objects of any hypothesis, *i.e.*, to the *supposed* existing things, which we are to suppose to be in existence so long as we are making use of the hypothesis. Thus, under the hypothesis made use of in Geometrical Optics, it would be intelligible to speak of rays in front of a mirror as having an *objective* existence; which would mean that they are the 'objects' of that hypothesis, *viz.*: what we are to regard as being in existence under that hypothesis. But it is usual to make the terms object and objective more definite by restricting them to one particular hypothesis; and unless it is otherwise specified, they will be applied in the present essay only to the objects of that *great* objective hypothesis described in the present chapter, which by 'the synthesis of the second order' supplies us with what are popularly called the natural objects about us.

¹ See Professor Alfred M. Mayer's experiments on the mosquito, in which he satisfied himself that the male insect can determine the direction of a sound within an angle of 5° (*Philosophical Magazine* for November, 1874, p. 380).

Men and dogs and other animals, and among men different individuals, are able to make this synthesis with more or less success. It is made with most success when the *conceived* perceptions, which are so large a part of the syntheton, are correct pictures in the mind of what they would prove to be if the proper measures were taken to make them in succession actual perceptions. Accordingly, the 'objects of nature' about us may appear to one man somewhat different to what they do to another. In the present chapter we have dealt with them as 'sensible objects,' *i.e.*, as the objects of nature, such as they present themselves to 'the man in the street.' In subsequent chapters we shall deal with them as they present themselves to scientific men; and it will then become apparent why the scientific objects of nature are to be regarded as constructed with more success than the mere sensible objects of uninstructed men.

It may also be noted that, while we are what is popularly described as 'looking at' or 'touching' or in other ways 'exercising our senses upon' the objects about us, these syntheta of perceptions are made up of perceptions a very small part of which are in autic existence, while the bulk of them have only an objective, *i.e.*, a supposed, existence. Thus, while I am looking at a chair or table, the sensible object is made up of my actual visual perception at that time, and of a great body of conceived perceptions which have to be joined to it to make up the whole syntheton: there is, as it were, a veneer of auto with a hinterland of hypotheta; forming, when combined, a syntheton which, viewed as a whole, is a hypotheton.

CHAPTER 12. OF THE PHYSICAL HYPOTHESIS.

It will be well to treat of the Physical Hypothesis next, as it is a hypothesis which is entertained and made use of, with more or less success, by all men, and not by scientific men only.

Natural science may be defined as the investigation of how nature [works]', of how and why events in nature [occur]'. In this definition we have to use the verbs *work* and *occur* in their objective sense, since what have [really] done the work have been, not the hypotheta which people the objective world, but their antitheta in the universe of real existences. The relation between what goes on in the autic universe and the events which as a consequence appear in the objective world may be likened to the relation between the

motions of a great machine and the movements amongst the shadows which the parts of the machine cast when the sun shines. If the machine moves in an orderly manner, so also will the shadows move in an orderly manner; and Natural Science is the study of these movements amongst the shadows. If we had adequate access to the machine, the best way to investigate the movements of the shadows would be to study what takes place in the machine, and from it to forecast what must happen among the shadows. But, unfortunately, though we can see the shadows, we can bring only an excessively small part of the machine under close inspection, and we have but glimpses of the rest. The only part of the stupendous autic universe which a human being can *adequately* examine is that excessively small group of auta which are the thoughts of his own mind, with the similarly small groups that are the minds of his fellow-men and of some other animals: he cannot even make any adequate study of the events that go on within the synergos which is so closely associated with his mind, and can only collect mere scraps of information as to what the real events are throughout the rest of the vast machine. As to that tiny group of auta that are one human being's thoughts, it bears somewhat the same relation to the mighty whole of the autic universe as their protheton, namely, some of the more slowly changing events within the cortex of his brain, bears to the enormous totality of motions that are going on objectively throughout the whole of nature. This makes it evident that the part of the autic universe that man can adequately examine is but one drop of an immeasurable ocean, and although that little drop is an actual specimen of the kind of things that auta are, it is very plain that we are not justified in assuming that it is a fair *average* specimen of them.

Working under these disadvantages, man (and the same is true of the more intelligent of the lower animals) has constructed the *Physical Hypothesis* whereby to enable him to form a correct forecast of the changes which will occur in nature. The physical hypothesis is the supposition *that the objects of nature can act on one another*, either directly (action at a distance) or through intervening media (which by many is supposed to be an essentially different kind of action). Now the objects of nature are syntheta of perceptions and ultra-perceptions (as appears from the last chapter read along with those which follow); and syntheta of perceptions cannot be what really act. Nevertheless, it is eminently useful to carry on our investiga-

tion under the physical hypothesis that it is they which act, and to confine our efforts to tracing out what effects this action must be supposed capable of producing, and under what laws it must operate, in order that it may account for what occurs in nature.

This, however, is felt by many persons to be too abstract an attitude of mind ; and, to satisfy them, and import into the hypothesis the plausibility which they demand, by relieving the fundamental conceptions of what is oppressively felt as the absurdity of supposing that syntheta of perceptions act, it is usual to supplement the syntheta by piling an aërial Pelion upon this solid Ossa, and by supposing that in addition to the *sensible object* which occupies any portion of space there is what is called *its material substance* occupying the same position, which, partly directly and partly by its motions, acts on other material substances—the ether being one of these so-called *substances*. According to this, which is the prevalent hypothesis among both scientific and non-scientific men, it is these ‘substances’ which travel about through space ; and the sensible objects, which are what we see and feel, are supposed to accompany them in their peregrinations by reason of the way in which they, the substances, act (usually through intermediate ‘substances’) upon our organs of sense.

This is the usual point of view : but more careful thinkers will do well to eschew this somewhat convenient, but by no means necessary, encumbrance upon *the unadulterated process of physical investigation* which treats the sensible objects themselves, the bare syntheta of perceptions and ultra-perceptions, as though they were what bring about the changes that occur in nature ; and will do well to occupy themselves exclusively in tracing out the laws that must, under this *hypothesis*, be in operation in order that the effects may be what they are.

This, the true physical hypothesis, is eminently useful and is therefore legitimate ; but the addition that has been saddled upon it, that there are ‘material substances’ present, is unnecessary, and as it is misleading and tends to keep out of view the really existent autic universe, it ought to be discarded by all persons who wish to think clearly. This is the course which all careful thinkers should prefer, because it keeps clearly before our minds that in the Physical Hypothesis we make use of a hypothesis and not of a theory. By being thus careful we avoid the risk of throwing dust in our own eyes. It cannot be too distinctly kept in view that the

justification of the physical hypothesis is its utility, not its truth—its incomparable efficiency as a means of investigating nature. This is a matter about which it is far better, although it cannot be said to be essential, that students of Physics should make no mistake.

It is obvious that causation, in the full sense of that term, can operate only between the real existences of the autic universe, and that everything else that appears to us to take place is a consequence of what occurs there. In fact, efficient cause and autic cause are synonymous terms.

Nevertheless, it is convenient and quite legitimate for scientific men to speak of 'physical' causes, meaning thereby what they have to treat as causes when engaged in carrying on an investigation under the Physical Hypothesis.

A very useful scaffolding which helps us in building up our investigation is the introduction of *forces* between the physical cause (which is always the vicinity of some natural object) and the effect to be attributed to it under the physical hypothesis. We are thus enabled to speak of the acceleration of a stone in its fall towards the earth, either as being due to the neighborhood of the earth, or as being caused by a force of gravitation which acts on it, which force is, in its turn, regarded as brought into existence by the proximity of the earth to the stone. The introduction of this piece of intermediate scaffolding is found to be of service—

1. Because the force can be represented by a line whose length accurately represents the intensity, and whose direction accurately represents the direction, *of the effect upon the stone* of the vicinity of the earth ;
2. Because the same effect upon the stone might have been due to other physical causes, as, for example, to a spring urging it forwards ; in which case the same piece of scaffolding, a force represented by the same line in the same position, would occupy its place between the cause and the effect ; and
3. Because the effect might have been different, while the physical cause remained the same : thus, if the stone lay on the ground, what the vicinity of the earth would have occasioned is stress between the stone and the ground.

Accordingly, by referring effects in nature to the operation of

forces, we are enabled in each case to indicate with accuracy *the intensity and direction of the effect*, without having to specify (*a*) which of several possible physical causes is the one in operation, or (*b*) which of the possible kinds of effect is that which is being produced: and this in practice is found to be an immense convenience.

Such is an outline of the principles that underlie the dynamical investigation of nature, which is the form of investigation that penetrates most deeply into its secrets.

CHAPTER 13. OF SPACE RELATIONS.

In order to apprehend clearly how much has been accomplished by synthesis it is advisable that we should scrutinize more closely space relations, and man's instinctive judgments about them: and as these judgments are a more conspicuous factor of my visual and tactual perceptions than of others, it will be instructive to treat specially of them.

Many slight muscular and other feeble sensations accompany the use of my visual and tactual organs of sense. These obscure sensations are constantly changing while I am using those senses, and in an excessively complicated way. That out of such tangled material synthesis has been able to evolve so simple a result as my judgment about space relations is because, amid all the apparent disorder, there *do exist* [*real*] *relations* between those much varying sensations; and the syntheton which can be produced depends on what these relations are. They in turn depend on what relations exist between my [organs of sense] and the various parts of the auto which is transmitting messages to me; for it is while varying these that the sensations in question arise. Hence, finally, the synthesis which can be effected *depends on what relations prevail in the autic universe between my [organs of sense] and other parts of that universe*. We have no reason to suppose that these onto-relations as they may be called, these relations between auts, are in the least *like* space relations, the space relations being syntheta constructed out of the obscure sensations that are indirectly occasioned by the onto-relations, after these have been worked up by the mind and its synergos with memories of past experiences and other materials.

Whatever the onto-relations may actually be, *they are at all events*

a part of those conditions in the autic universe which determine whether auta can act upon auta. So much I know, because I have to adapt my organs of sense to them in order to get tekmeria; and it is in doing this that I experience the complicated sensations which have come, by reason of what has occurred in my long series of ancestors, to be synthetized for me into instinctive judgments of objective space relations between perceptions. It is evident then that my judgments about space relations are the result of a synthesis of materials which are themselves consequences of relations that prevail in the autic sense-compelling universe. It is these onto-relations, whatever they are, that have an autic [existence]: the space relations have only an objective [existence]'. This means that we are to treat these space relations *as though they existed* whenever we are availing ourselves of the great and most useful objective *hypothesis*, which supposes that not only do our perceptions exist but that the hinterland also exists which with them make up what are called the natural objects about us. But while making every possible use of this hypothesis, we ought, if we care to think clearly, to keep steadily before our minds that this is a hypothesis *to be made use of*, but not the correct theory *to be believed*.

CHAPTER 14. OF MOTION.

We are now in a position to deal with the important subject of motion. The *appearance* of motion is an auto, a perception in my mind; and while this perception lasts it is a tekmerion, a proof to me that an event capable of producing this appearance has occurred in the sense-compelling autic universe. This event could send different tekmeria to me, according to the way I employ my senses upon it; and the syntheton formed by putting all these together is what is meant by the term *motion*. It is accordingly a part of the great objective Hypotheton which we call Nature. If we want to indicate the real occurrence in the sense-compelling universe, we may speak of it as the onto-motion or aitia-motion, meaning by these terms the autic event which corresponds to the synthetomotion in the objective world. It is an antitheton, and the synthetomotion is the corresponding protheton. The word motion, like all similar terms, is ambiguous, and in common speech it has to be sometimes interpreted as meaning the protheton in the objective world, and in other contexts as meaning its antitheton in the uni-

verse of real existences. The protheton is in fact a kind of synopton, or conjoint view, of the actual effects which are at that time being produced and of the possible effects that might have been produced, within modern men's minds, by its antitheton the ontomotion. It is necessary to describe it as a *kind of* synopton, since the materials that come in, or could come in, from abroad are modified by being worked up with materials contributed by the mind and its synergos.

CHAPTER 15. OF THE PHENOMENON, OR PHENOMENAL THOUGHT; AND OF ITS RELATION TO THE PHENOMENAL OBJECT.

The word phenomenon has three established meanings: 1. It is used by metaphysicians to mean thought in the mind. This is the original or at least an early meaning of the term: the other meanings are of recent date. 2. It is used to mean an extraordinary circumstance. This is the popular acceptance of the word. 3. It is used to mean any natural object or event in nature. This is the meaning attributed to it in works on Natural Science.

For the sake of convenience it is well to assign a name to my thought about an object of nature, or as it is often called a phenomenal or sensible object. My thought about it we may call the phenomenon, or phenomenal thought, availing ourselves of the first of the above meanings of this term. Accordingly the phenomenon within my mind at any particular time consists of all or some of the following:

1. The actual perceptions which at that time the sense-compelling auto is producing in me, if there are any such perceptions existing in my mind at that time.
2. My memory of the perceptions which that auto has on other occasions produced in me.
3. My anticipation of such perceptions as I suppose it would produce in me under other circumstances.
4. Certain suppositions with respect to this group of perceptions.

This phenomenon, or phenomenal thought, is itself an auto, a part of my group of thoughts; while, in contrast to this, it is only as a hypothesis that *the object of this thought*, the phenomenal object, can as a whole be regarded as in existence. Part of it no doubt

may be temporarily in existence, viz. : so long as the sense-compelling auto which is the source of the perceptions happens to be acting on me through my senses. During this time some of the perceptions that go to make up the phenomenal object *are in actual existence*, but only as a part of my group of thoughts. None are in existence independently of the mind, nor are any of the rest of the perceptions that go to make up the phenomenal object in existence at that time either in or out of the mind. That the whole phenomenal object is supposed to be in existence and to be distinct from the mind is therefore *a hypothesis*; most useful, but not to be thought of as *the true theory*. On the other hand, the *phenomenon*, i.e., my thought about the phenomenal object, while it has the advantage of being an auto, is transitory, imperfect, very variable, and almost always erroneous in some respects; depending as it does on the extent of my information and the amount of attention I give to it: while the *phenomenal object*, though a hypotheton, has in it nothing in the least shifting or arbitrary. *It is perfectly definite*: including as it must *all the tekmeria* which its antitheton, the sense-compelling auto, *does actually or can legitimately* create in human minds through human organs of sense. It is intended by the word *legitimately* to exclude cases of illusion, or defects that arise through imperfection of the senses. Legitimately is to be understood as meaning when every part of the line of communication is working normally and satisfactorily.

CHAPTER 16. OF THE PHENOMENAL OBJECT, WITH WHICH NATURAL SCIENCE DEALS.

It is in accordance with the signification we have given to the word [real]', when written with a dash, that motion in the phenomenal world shall be deemed real when it is a syntheton of the actual perceptions which an onto-motion does or of the potential perceptions which it could produce by acting on human minds through human senses. But Science, in its progress, has found this definition too cramped. The definition would limit the stamp of being *real* to those cases in which man's senses are competent to act as channels of communication between the sense-compelling universe and him. Now, scientific investigation has penetrated much farther than this—even the flimsy appreciation of what goes on in nature which is necessary for man's everyday work, renders

essential some extension of the meaning of the word *real*—and accordingly the exigencies of common life, but more especially of scientific inquiry, have made an extension inevitable, so that a motion or other part of the Objective Hypotheton is still to be regarded as [real]', although too small or too rapid or in some other way unfitted by its time or space relations to be a syntheton of human perceptions, *whenever justification for this extension exists*. The objects with which the scientific student of Nature has to deal are in fact syntheta of—

1. Actual perceptions ;
2. Potential perceptions ; and of
3. Certain ultra perceptions, namely, those which scientific investigation does or can warrant.

By an ultra perception is to be understood what would be a perception, if our senses were more acute.

These are more than the syntheta of actual and potential human perceptions which we have called sensible objects, and to distinguish them it will be well to give them a different name. We shall call them *phenomenal objects*. They are in much closer relation to what is actually going forward in the autic universe than it is possible for the 'sensible objects' to be. This is a necessary consequence of the restricted range of the senses possessed by man, by which the amount of detail which can be present in the sensible object is limited.

CHAPTER 17. OF THE DIACRINOMINAL OBJECT.

Motions are by far the most important part of the phenomenal hypotheton, as will be obvious from the following considerations. Scientific investigation has brought to light the significant facts which are described in common language by saying that men and animals receive their sensations of sound from motion in the air, of light from events in the ether which can be ultimately analyzed into motions, and in the same way their other sensations from motions somewhere in Nature. This, put into less objectionable language, is equivalent to the statement that the autic and autic events of the sense-compelling universe which produce in me the sensation of sound through one channel of communication, viz., through my sense of hearing, are such as are also competent to produce in me through other channels, namely, through my senses of sight and

touch, another tekmerion, viz.: the perception of motion; or, at least, differ only from those autic causes which are capable of producing an actual perception of motion through those senses, in the way that the autic cause of the perception of one visible motion differs from the autic cause of the perception of a similar visible motion which is swifter or slower or on a different scale.

These remarkable discoveries have led scientific men to entertain a new and very important view of nature, in which it is regarded as made up of objects each of which consists of almost inconceivably minute and swift motions. These and the drifting about in space of some *objects, i.e.,* of some *masses of internal motions*, are the whole of this hypotheton. It may be regarded as the utmost simplification of which any synoptic view of the effects produced within the human mind by the mighty march of actual events in the real universe is susceptible; and it is therefore that synoptic view of those effects which stands in closest relation to the autic causes that have produced them.

The remarkable hypothesis described in the last paragraph may appropriately be called the *Diacrinominal Hypothesis*, as it has discriminated between the various tekmeria produced within us by the autic universe, and has selected for further synthesis one special group—our perceptions of motion—on the ground that it, and that it alone, is able *by itself and without being mixed up with other tekmeria* to people Nature with objects which are *complete* as bodying forth in a collected form the information sent us by the real auta of the actual sense-compelling universe; and which, owing to their simplicity, stand in a closer relation to those auta than the more complex objects of Phenomenal Nature. Phenomenal objects are bright, warm, hard or soft, colored, sweet or bitter, and so on; as well as moving or at rest. In diacrinominal nature motions take the place of all these. An attempt was made to give a summary of the results of this hypothesis in a Friday Evening Discourse, delivered before the Royal Institution of Great Britain in 1885, and printed in the *Journal* of that Society, so that it is the less to be regretted that it would make this paper too long to dilate upon them here. We may therefore pass at once to the consideration of the last circumstance which it seems necessary to make clear in order that we may be at length in a position to understand how the scientific study of objective Nature stands related to the real

existences and real activities of which the true universe actually consists : which is the problem we proposed to investigate.

CHAPTER 18. OF PHYSICAL CAUSES AND OF EFFICIENT CAUSES.

Causation, in the full sense of that term, implying efficiency in the cause, can only prevail in the operations of autā.

When an efficient cause operates within the sense-compelling universe, it produces some change therein, and if this change be such that the sense-compelling universe can produce one set of effects within human minds before the change and another set after the change, then will the hypothetical existence which we call nature also undergo a change. This is because nature before the change is the syntheton made by fitting together the former set of possible effects, and nature after the change is the syntheton of the latter set of possible effects. We may liken the sense-compelling universe to a mighty machine, and nature to a shadow cast by it in a very special way. If the machine is set in motion and changed from one position to another, it produces one shadow before the change and another after ; and if the change in the machine has followed a definite order, the second shadow will succeed the first in a corresponding orderly sequence : but the relation between the shadows is not the relation of cause and effect.

Accordingly, in the laws of Nature which have been discovered by scientific investigation we find abundant instances of unfailingly concomitant events and of uniformities of sequence, but not a single instance of genuine cause and effect. The so-called Physical causes are not causes in the full sense of that term. We might write them as [causes]' with a dash, but not as [causes] without one. Nevertheless it is *legitimate as an hypothesis*, to treat them as though they were causes when and so long as we are engaged in making use of the Objective Hypothesis. If a stone be allowed to drop in the vicinity of the earth, its downward speed is accelerated by a perfectly definite law. In this case the vicinity of the earth to the stone and the acceleration of the stone's vertical velocity are two unfailingly concomitant events. This is one of the Uniformities of Nature which scientific inquiry has brought to light. But *within the domain of Physics* there is no *cause* for the acceleration. To reach the cause we must travel beyond the hypothetical domain of Physics and study the events that have taken place in the universe of real

existences. If we confine our view to Nature, the facts as to what occurs can be observed ; the circumstances under which they occur can be investigated ; similar cases can be compared ; and the laws to which the simultaneous or successive events conform can be brought to light. But here the knowledge conveyed to us by the great Objective Hypothesis ends: Physical Science has said its utmost.

Now all this is changed when we turn to the only field of observation accessible to us in which we are dealing directly with *auta*. The thoughts of which I consist, the thoughts that are my mind, are *auta*: no doubt a very small group of *auta* in the stupendous totality of all *auta*, but still *an actual sample*, although a very special and perhaps one-sided sample, of what *auta* are. In the operations that go on in my mind I do find instances, some few instances, of causes producing effects. The familiar case of a geometrical demonstration producing in a man's mind a belief in the truth of the conclusion is a case in point. Here the understanding of the proof is *the efficient cause* of the belief in the conclusion which accompanies that understanding. A wish to accomplish something, and a knowledge of how to go about it, are part of the autic universe since they are thoughts, and they are a part of the efficient cause of subsequent events in the autic universe, unless counteracted by other causes. A few other examples can be obtained from the same small field of investigation: and this is all that man, in his isolated position, has any right to expect; for the bulk of his thoughts are due, at least in large part, to autic causes which lie outside his mind, either in the synergos or beyond it in the sense-compelling part of the universe; and it is there also that those of his thoughts that are known to be causes usually exhibit their effects. When perceptions or when memories arise in my mind, the effect is indeed within my mind, but the cause lies beyond it; and when 'I move my muscles,' the cause is within my mind, but it is outside my mind, upon the antitheta of those muscles, that it operates. The instances are indeed few where the causes and the effects are *both* within my tiny group of *auta*, and it is only in these few cases that I can have the process of causes producing effects under my inspection.

But since cases can be cited, however few, they suffice *to establish the fact* that the relation of cause and effect in its full sense

does exist in some instances in the autic universe ; whereas it has nowhere any place within the domain of physical science. I am even under the impression that every event which has occurred in the real universe, every change that has taken place there, has been, as a matter of fact, brought about by true adequate causes ; although I am bound to admit that man lives too secluded from the rest of the universe, and with channels for communicating with it that are far too indirect, for me to be entitled to dogmatize and to say to myself or my fellow-men that I absolutely know this to be so. At the same time it recommends itself to my mind as intrinsically probable ; and it is supported by direct evidence which makes it seem to me *probable* in a high degree—

1. Since there are some instances in which the whole process of causation operating among auta can be observed ;
2. Since no instance can be found in which observation is possible, and in which it does not prevail ; and
3. Since the alternative supposition appears to be improbable. The only alternative is that, while the few changes among auta which can be investigated are found to be due to adequate causes, the rest, or some of the rest, which we cannot investigate are uncaused.

All men experience within themselves what is called the freedom of their Wills ; and this may by some be regarded as presenting an exception to the second of the above statements. But no amount of introspection has enabled me to detect any exercise of my Will which had not been caused by some motive, *i.e.*, by a thought which forms one of my group of thoughts, or else by some inherited or acquired habit ; that is, by the intervention of my synergos. This shows me that what I describe as the freedom of my Will does not exclude adequate causes.

It is noteworthy that statistical inquiries have revealed to us the fact that averages taken over great numbers of the acts due to the free exercise of the Wills of human beings, conform to definite laws. This suggests that a corresponding freedom of the Will may prevail throughout the mighty Autos—the totality of all auta—and may, nevertheless, produce perceptions in egoistic minds (*i.e.*, in minds supplied by the Autos with information through organs of sense) of such a kind that these perceptions when synthesized into the objects of nature exhibit that orderly sequence of events which we

find in nature. For this, it would be only necessary that perceptions should be caused in us not by individual events in the mighty Autos, but by vast swarms of such events operating together and producing in us an average effect. And this, on other accounts, seems to be the case (compare, for example, the significant slowness of human thoughts with the swiftness of molecular [events]'). If this view be correct, what are known to us as the [Laws]' of Nature are an outcome from [Laws] of averages among auta. To attempt to penetrate farther lies beyond the scope of the present essay. We must not be tempted to engage here in the study of the little that man is competent to learn about the individual events that are in progress amongst the auta of the sense-compelling part of the universe, or the efficient causes that operate there.

CHAPTER 19. RECAPITULATION.

What has been chiefly learned in the foregoing pages is: 1. That the objects of nature are syntheta of perceptions; and 2. That there is no warrant for our assuming that the true autic cause of human perceptions, or of the events that occur among the objects of nature, are in the least like those objects. On the contrary, every evidence that we can collect points to the conclusion that the true source of the perceptions of our egoistic minds, and of those events in nature which are usually attributed to an interaction of the objects of nature upon one another, is in reality as utterly unlike those objects of nature as the thoughts of a man are unlike the events within his brain associated with those thoughts.

These considerations when followed up lead us to reject the common belief in 'material substances' as erroneous, and it is moreover found to be misleading. It is an error which blinds the minds of those who entertain it to the stupendous Autic Universe, which is what really exists, and which transcends the supposed material universe as much as do the boundless range and vast variety of the thoughts of a human mind altogether differ from and infinitely transcend that selection of movements within the brain which accompanies those thoughts.

A theory of existence, such as that which we have sought to expound in this essay, is to be judged, not by the use we are able to make of it, but by its truth. At the same time this theory is far from being useless to the thoughtful student of nature. It becomes

available just at those points where the assumptions usually made by scientific men leave us in the lurch—as when we are brought face to face with the problem of the true relation between a man's thoughts and the events in his brain associated with them ; or when the problem is to ascertain of what kind are the true efficient causes of those events that occur about us in nature.

APPENDIX.

In the foregoing pages the author has freely used passages extracted from others of his writings, altering them and adding to them so as to obviate, as much as in him lay, difficulties which have been felt by some of the readers of those preceding papers ; and his hope is that none of these difficulties will be felt in reading the present essay.

The attempt has been made to keep to that one special path through the territory opened up to us by the study of ontology, which pursues its way among the topics of most use to us as scientific students of nature. But much may be learned by other excursions into this great field of exploration, and they end in presenting us with a spectacle of unsurpassed sublimity.

It may be well so far to trespass upon this new ground as to mention some results of the further inquiry. In certain parts of the new territory we have to venture on less firm ground than that which we have trodden in the preceding essay, and must be content with results arrived at with probability. It is then found that such evidence as can be brought to bear appears to tend with considerable emphasis to the conclusion that not only the *auta* that are our minds are thoughts, but that the same is true of the *auta* that are our *synergos*. Now the mind and its *synergos* are, when taken together, the *antitheton* or true autic existence corresponding to the objective brain. A similar conclusion is indicated with regard to the rest of objective nature. The *antitheta* of the objective events—the true autic events which correspond to them—seem, with a considerable degree of probability, to be essentially thoughts ; most of them no doubt with vastly different time relations to those of the thoughts that are the human mind, but still in several material respects not unlike them. If this view is correct, the only things that [really] exist are thoughts, and the effects produced by

thoughts upon thoughts ; and the laws of averages spoken of above in Chapter 18 are part of a much greater group, viz., the Laws of Thought in general, which if this view is correct are the real ultimate laws of the real universe. It will of course be seen that the laws of thought here spoken of are different and altogether beyond that paltry little group—the laws of human thought—to which they stand related much in the same way as does the whole science of dynamics to the laws of the movements of a watch.

Egoistic thoughts, such as those of the human mind, must be related in the way that we call being within the same consciousness, in order to be able to influence one another. The understanding of the steps of a proof by my mind does not produce any perception of the truth of the conclusion in another mind. The effect and the cause must both be within a group of thoughts that fall within one consciousness. Starting from this, and collecting all the evidence available, we are ultimately led to the conclusion that the Autos, the totality of all thought, is a universal mind, meaning by a mind thoughts related to one another in the way that is described by saying that they are within one consciousness. This, if true, is a very pregnant conclusion, leading on further study to very important results.

Again, the perceptions produced within egoistic minds by sense-compelling autas are an exceedingly trifling part of the great march of autic events, whence but little would be lost out of the great procession if they were discontinued, as would happen if such minds as those of men and animals ceased to be produced. With them, however, the whole 'material' universe, the great objective hypotheton, would come to an end. Similarly, it was created, not at once, but gradually according as the minds that consist of egoistic thoughts by degrees acquired the power of transforming sensations into perceptions, and the power of synthesizing the perceptions into the objects of nature.

Similar reflections meet us at every turn while we are engaged in prosecuting the further investigation ; but it would lead us too far from the immediate object of our essay to refer further to them in this necessarily desultory way.

The inquiry on which we have had to enter may be approached either in the skeptical or in the scientific frame of mind. These are not only different but opposed. The motive which rouses the scientific man to exertion is his earnest desire for the increase of

knowledge. For this he is willing to do his utmost in any and every direction that is open to him. The motive which controls the philosophical skeptic is his fear of a false step. He is indisposed to stir at all until secure of his footing. The mind when in a scientific attitude is patient even of known error, if only it can be made the basis of a really good working hypothesis that will help the inquirer forward, and which may then become susceptible of revision and correction. Numberless instances can be given in which this process has led to valuable results. In fact, most of man's scientific knowledge of nature is owing to it. But such a method is repugnant to the philosophical skeptic, whose attitude damps all advance unless it can be carried on from the beginning under conditions of perfection—in other words, under conditions which are impossible in the early stages of almost every inquiry.

30 LEDBURY ROAD, LONDON, W., March, 1903.

HINTS ON THE CLASSIFICATION OF THE ARTHROPODA; THE GROUP A POLYPHYLETIC ONE.

BY ALPHEUS S. PACKARD.

(*Read April 3, 1903.*)

Of the ten or twelve chief groups or phyla into which the animal kingdom is subdivided by systematists, nearly all except those of the old groups Vermes and the Arthropoda are acknowledged to be fairly well limited. There is a general agreement of opinion as to the naturalness and monophyletic origin of the Protozoa, Porifera, Cœlenterata, Echinodermata, Mollusca and Chordata. Those of the "worms" and the great group Arthropoda are still the cause of more or less difference of opinion.

The group Arthropoda was established by Siebold in 1848, but in late years, with the increase in our knowledge of the morphology and embryology of the Arthropodan classes, especially of the Trilobita, Merostomata, Malacopoda (Peripatus) and Myriopoda, there has been expressed by several zoologists the opinion that the Arthropodan phylum is a more or less artificial one, and should be subdivided into more natural groups—*i. e.*, that it is composed of several phyla.

Were it only a matter of convenience, the great group Arthro-